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imagery analysis report

New-Type Hardened Antenna at Shagan River and Voronezh, USSR (S)



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NEW-TYPE HARDENED ANTENNA AT SHAGAN RIVER AND VORONEZH, USSR (S)

INTRODUCTION

1. (S/WN) Prototypes of a new-type hardened antenna were constructed at Vulnerability Area 108, Shagan River Test Area [] and at Voronezh Radio Communications (Radcom) Research and Development (R&D) Test Station/Hard [] in the USSR. The antenna at Voronezh is a buried multi-element array, 160 meters long and 34 meters wide. The antenna at Shagan River, which was a part of a 1980 vulnerability test, was about the same length but only half as wide. This report presents the construction history and significant details of these antennas.

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HISTORY

Shagan River Antenna

2. (S/WN) The Shagan River Test Area is a part of the Semipalatinsk Nuclear Weapons Proving Ground. Shagan River is used for vertically emplaced underground nuclear testing and for high-explosives (HE) vulnerability testing of strategic structures. Vulnerability Area 108 is one of several areas within Shagan River where HE vulnerability testing is conducted. Many of the items which have been tested in Area 108 have been command, control, and communications (C3)-associated structures or antennas.

3. (S/WN) The new-type hardened antenna was built within Area 108 during the summer and fall of 1980 and was tested for HE vulnerability on []. The antenna was constructed in a 170-by-17-meter trench along the eastern fenceline of Area 108. The trench was [] deep except for the central section which had been backfilled to ground level, dividing the trench into two 80-meter-long test beds. Branching antenna cables were then laid out in the two test beds. The antenna cables were connected through the backfilled center of the trench and from there to an instrumentation bunker. An additional cable trench extended to the northern test bed. The antenna originated on either side of the center section of the trench as four parallel cables spaced approximately 4 meters apart. These cables branched into eight cables 30 meters down the trench. The eight cables were about 2 meters apart and 15 meters long. These eight cables then branched into the last section of 16 cables, also 15 meters long and 1 meter apart (Figure 1).

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4. (S/WN) After the antenna was laid out, the test beds were backfilled to ground level and HE simulators were built over and adjacent to the northern test bed. This arrangement of HE subjected the northern half of the antenna to more severe ground shock than the southern half. During the 1981 test series, a modified bi-grid antenna was tested for vulnerability in Area 108 using a somewhat similar arrangement of HE. In that test, only one of the four quadrants of the bi-grid was directly subjected to the ground shock created by the HE simulators. Both the new-type hardened antenna and the bi-grid antenna were large buried cable antennas. Complete details of these HE vulnerability tests are available in the 1980 and 1981 Soviet Vulnerability Testing Reviews.^{1,2}

Voronezh Antenna

5. (S/WN) The Voronezh Station is a research facility involved in the development of hardened radcom antennas. Many of the hardened antennas developed for use at Strategic Rocket Forces (SRF) missile silos and command centers were built and tested at Voronezh prior to their deployment. The Voronezh facility has been operational since at least 1969. There is some evidence to suggest that diagnostic testing at Voronezh includes studying soil conductivity and propagation by buried antennas.^{3,4}

6. (S/WN) Cable trenches for the new-type hardened antenna at Voronezh were first imaged on 21 May 1981. The trenches were dug parallel to the eastern fenceline of the facility on a north/south orientation in an area 160 by 34 meters overall and divided into seven sections. The center section was 30 meters long and divided the antenna into northern and southern halves. Each half of the antenna consisted of three sections, one each of eight, 16, and 32 parallel trenches. The two sections adjacent to the center section each contained eight trenches, 27 meters long and spaced [] apart. These sections were [] wide. The next sections contained 16 trenches, 19 meters long and spaced [] meters apart. These sections were 33 meters wide. The end sections of the antenna contained 32 trenches, also 19 meters long and spaced [] apart. These sections were [] wide (Figure 2).

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7. (S/WN) The cable trenches in each section were offset from the trenches in the adjacent sections, giving a branching appearance to the antenna. By [] the cable trenches were being backfilled and the antenna had probably been completed.

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IMAGERY ANALYST'S COMMENTS

8. (S/WN) Although the Shagan River antenna is just half the width of the Voronezh antenna, they are sufficiently alike in size, element spacing, and configuration to be of the same basic design. The spacing of the elements of both antennas is virtually the same, [] at Voronezh and [] at Shagan River. There is a greater difference in the length of the elements. The lengths of the elements at Shagan River are 30 and 15 meters, a 2:1 ratio, and the lengths of the elements at Voronezh are 27 and 19 meters, a 3:2 ratio. Both are symmetrical. It may be that the very carefully excavated trenches at Voronezh are a more accurate reflection of the size and spacing of the antenna the Soviets intend to deploy. The antenna array laid out in the test beds at Shagan River may simply have met minimum specifications for testing this type of antenna.

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9. (S/WN) Although the design of the two antennas is similar, the timing of their construction is unusual. Previous hardened antenna development cycles have not started with vulnerability tests. It is highly probable that the basic design stages were complete and that much of the design testing was underway prior to the construction of the antenna at Shagan River. This implies that a facility exists for design and scale model tests and perhaps another facility where the first full-scale antennas are built and tested. The locations of these facilities, if in fact they do exist, are unknown. The design of an antenna would normally be complete prior to vulnerability tests at Shagan River and conductivity tests at Voronezh. The new-type hardened antenna is not the only antenna to be identified at what appears to be a mid-point in the development cycle. At least one new antenna, possibly two, was built and tested in Area 108, Shagan River, during 1981. One was shaped like a truncated hexagonal pyramid. Another test of an unidentified object atop or in a 1-meter-diameter shaft of unknown depth may also have been related to communications. The apparent out-of-sequence appearances of these new antennas for vulnerability tests prior to their appearances at Voronezh or other developmental facilities also suggests that there may be other facilities in the USSR involved in the early development of hardened antennas.

10. (S/WN) During the development of the phase II hardened antennas in the early-to-mid 1970s, the antennas were first identified at Voronezh. A short time later, antennas were built at Tyuratam Missile/Space Test Center [] and then at the deployed missile sites. No antenna resembling the new-type hardened antennas at Shagan River and Voronezh has been built at Tyuratam. This suggests that, unlike the phase II hardened antennas, the new-type antenna will not be deployed at ICBM silos but may instead be deployed at C3 sites.

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REFERENCES

IMAGERY

(S/WN) All available satellite imagery acquired through [] was used in the preparation of this report.

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DOCUMENTS

1. NPIC. Z-20181/81, IAR-0162/81, 1980 Soviet Vulnerability Testing Review, Shagan River Test Area, USSR (S), Nov 81 (SECRET) []
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3. CIA. [] WI WIS 77-35J, Weapons Intelligence Summary: Hardened Antennas Identified at Voronezh Electronics R&D Station, 22 Feb 77 (TOP SECRET) []
4. DIA. [] DST-1080R-115-77-SAO-SPR-3, Analysis of a Soviet Antenna R&D Facility (U), 30 Sep 77 (TOP SECRET) []

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